Section-2

CTs, CVTs and PTs

1. SCOPE: Refer Clause-1 of Section-I, General

2 CLIMATIC CONDITIONS: Refer Clause-2 of Section-I, General

3 GENERAL TECHNICAL REQUIREMENTS: Common for all instrument transformers (CTs, CVTs and PTs) :

The CPL / BPI structure of 2700 mm (min) height shall be used to maintain ground clearance of 4800mm (132kV), 5500mm (220kV) above plinth level.

3.1 Construction :

The core shall be high grade non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over current voltage.

The secondary terminals shall be brought into a compartment on one side of Instrument transformer for easy access. There shall be separate secondary terminal box for the dedicated metering core. The secondary terminals shall be provided with short circuiting arrangements in case of Current Transformers. The secondary taps shall be adequately reinforced to withstand normal handling without damage. The ratio taps shall be on secondary side and sealing should be provided for the dedicated core.

The mounting of instrument transformers shall be pedestal type and shall be suitable for mounting on steel structures or concrete pedestals. The necessary flanges, bolts etc., for the base of instrument transformers shall be supplied and they shall be galvanized.

All windings shall be made of double paper covering insulation and the manufacturing of the units shall be done in completely closed and air-conditioned room. Details of winding and core shall be furnished.

It shall be ensured that the Instrument Transformers are able to withstand all the stresses imposed on them while transporting and there shall be no damage in transit.

The Instrument Transformers shall be complete in all respects with first filling of oil conforming to IS-335/IEC 60296. It shall have oil level indicator with minimum/maximum oil level marks. The top cover and terminal box cover should be such that rain water does not enter even through the O rings. The manufacturer of CT shall test the oil for DGA before filling inside the CT and shall keep record of the same.

3.1.1. The insulation of the Instrument transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric-withstand values of external and internal insulation shall be clearly brought out in the guaranteed technical particulars. The Guaranteed Technical Particulars as given in the Specification shall invariably be mentioned in the bids furnished.

Those bids not containing the Guaranteed Technical Particulars will be treated as Non-Responsive and rejected. The dielectric withstand values specified in this specification are meant for fully assembled Instrument Transformers.

3.1.2 Porcelain Housing:

The porcelain housing shall be in single piece only, without any metallic joints. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength. Glazing of porcelain shall be of uniform brown or dark brown color free from blisters, burns etc., with a smooth surface arranged to shed away rain water or condensed water particles (fog). The profile of porcelain shall be aerodynamic type as per IEC-815.

The instrument transformers shall have cantilever strength of not less than 350 kg for 220kV &132kV Instrument transformers.

3.1.2.2 **The metal flanges of cast iron should be cemented to porcelain hollow insulator at both ends. Collar type/without cementing is not acceptable**. Details of attachment of metallic flanges to the porcelain bushing shall be brought out in the offer. Bushings shall be manufactured and tested in accordance with IEC:137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5621.

3.1.3 **Metal Tanks**: The metal tanks of Instrument Transformers of 132kV and above shall be of Aluminum Alloy and the thickness of metal tank shall not be less than 5 mm. The metal tanks of 33kV instrument transformers can be made of stainless steel/aluminum sheet/aluminumcasting/mild steel. The thickness of the metal tank of mild steel shall not be less than 3mm. The metal tank if made of mild steel can be Hot Dip Galvanized or painted. In case of painting, the outer portion shall be coated with at least two coats of zinc rich epoxy painting, whereas, the inner portion shall be painted with Two coats of hot oil resistive insoluble paint. The metal tanks shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage.

3.1.4 Surface Finish:

The metal tank if made of mild steel, can be Hot Dip Galvanized or painted. In case of painting, the outer portion shall be coated with Zinc rich epoxy painting, whereas, the inner portion shall be painted with Two coats of hot oil resistive insoluble paint duly after removing the zinc layer with sand blasting. In case of galvanizing, the galvanizing shall be as per applicable standard IS: 2629 and minimum thickness of zinc coating shall be 610 gm/Sq.mts (86 micron).

For Aluminium tanks and stainless steel, external surface of aluminium can have natural finish. The TSTRANSCO reserves right for stage inspection during manufacturing process of tank / equipment.

All the ferrous hardware, exposed to atmosphere, shall be hot dip galvanized or Aluzinc coating. All other fixing nuts, bolts, washers shall be made out of stainless steel only.

3.1.5 Insulating Oil:

Un-used EHV grade Insulating oil required for first filling of the Instrument transformer shall be covered in Bidder's scope of supply. The oil shall meet the requirements of latest edition of IS:335./IEC 60296. Non-PCB based synthetic insulating oil conforming to IEC 60867 shall be used in the capacitor units of CVT.

The impregnation details along with tests/checks to ensure successful completion of impregnation cycle shall be furnished at the time of final acceptance testing.

3.1.6 Prevention of Oil Leakage and Entry of Moisture:

3.1.6.1 The Bidder shall ensure that the sealing of Instrument Transformer is properly achieved. In this connection the arrangement provided by the Bidder at various locations including the following ones shall be described, supported by sectional drawings.

i) Locations of emergence of primary and secondary terminals.
ii) Interface between porcelain housing and metal tanks.
iii) Cover of the secondary terminal box.
iv) Oil resistant Epoxy cast resin/FRP bushings are to be used for primary terminals.
v) For terminating secondary connections from windings, molded oil-resistant epoxy cast resin terminal cover (epoxy monoblock) should be used. "O" Rings should be as per clause 3.1.6.3
vi) Between Top tank and cover.
vii) Between top cover and steel metallic bellow.

3.1.6.2 Nuts and bolts or screws used for fixation of the interfacing porcelain bushings for taking out terminals, shall be provided on flanges cemented to the bushings and not on the porcelain

3.1.6.3 For joints wherever used, nitrite butyl rubber/Viton /EPDM/neoprene "O Rings" shall be used. The "O Rings" shall be fitted in properly machined groove with adequate space for accommodating the "O Rings" under compression. The Test Certificate of the "O Rings" shall be submitted to the inspector during inspection. No Plain CORK gaskets shall be used.

3.1.6.4 Instruments transformers shall be hermetically sealed units. The details of the arrangements made for the sealing of instrument transformers shall be furnished during detailed engineering.

3.1.7 Oil Level Indicators:

For all current transformers & potential transformers, stainless steel metal bellows shall be provided for compensation of oil volume variation. Steel diaphragms are not allowed. A ground glass window shall be provided to monitor the position of metal bellow.

The level of shell shall be visible with naked eye to an observer standing at ground level.

For CVTs, the capacitor voltage divider units shall be provided with stainless steel bellows for compensation of oil volume variation, whereas the EMU shall be provided with nitrogen cushion. The level of bellow shall be visible with naked eye to an observer standing at ground level. The EMU shall be provided with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

All parts of bellow shall be of stainless steel only. All relevant test certificates of bellows should be produced at the time of FAT.

3.1.8 Earthing:

Instrument Transformers shall be provided with two separate Earthing terminals for bolted connection to 75 x 8 mm MS flat to be provided by the Purchaser for connection to station earth-mat. Suitable size flexible earth bonds shall be provided for connecting the instrument transformers with earthmat risers of the Substations.

3.1.9 Instrument Transformer shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing. Lifting arrangement (lifting eye) shall be positioned in such a way as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary removable type string guides shall be provided.

3.1.10 Name Plate:

Name plate shall conform to the requirements of IEC incorporating all the information as per the Annexure (name plate). Lettering on the Name Plate should be White/Silver colored on Black background and the same should be readable. Name plate shall be non-corrosive.

3.1.11 Terminal connectors :

The terminal connectors required for connection of the Instrument transformer to Purchaser's bus bar, shall be in Bidder's scope. In case of twin/quadruple conductor the terminal connector shall be suitable for both vertical and horizontal take off positions.

1) Terminal connectors shall be suitable for single/twin moose/ACSR conductor as per CT current carrying capacity and suitable for horizontal or vertical takeoff positions. Confirmation from TSTRANSCO shall be obtained regarding type of terminal connectors at the time of drawing approval.

2) Bushing terminals shall be provided with terminal connectors of approved type and size for connection to external parts. Terminal connectors offered must have been successfully type tested as per IS 5561 and must be procured from TSTRANSCO registered vendors only. Type test reports for Terminal connectors shall be provided from Original manufacturers.

3)
   i) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
   ii) No part of a clamp shall be less than 10 mm thick.
   iii) All steel bolts & nuts shall be hot dip galvanized conforming to IS 1867 part xiii and spring washers shall be Electro galvanized conforming to IS 1573.
   iv) For bimetallic clamp, copper alloy linear of minimum thickness of 2 mm shall be supplied which shall fix tightly.
   v) Flexible connectors shall be made out of tinned copper sheets.
   vi) Size of terminal/conductor for which the clamp is suitable and rated current under site conditions shall be embossed/punched on each component of the clamp, except hardware.
   vii) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
   viii) Clamps and connectors shall be designed to be corona controlled for 220kV & 132kV class. Corona extinction voltage for 220kV & 132kV class clamps shall not be less than 156kVrms, 105 kVrms respectively and R.I.V level shall not be more than1000micro volts & 500 micro volts respectively at the test voltages specified in respective sections.
   ix) The short time rating of terminal connector shall correspond to short time rating of respective bushing.

Clamps & Connectors must also be in compliance with type test ratings of the Instrument transformer's Thermal & Electrical standards.

All power clamps and connectors shall conform to IS: 5561:2018 & NEMA CC1 and shall be made of materials listed below:

a	For connecting ACSR conductors	Aluminum alloy casting, conforming to designation 4600 (A6) of IS: 617 and all test shall conform to IS :617
b	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminum alloy casting, conforming to designation 6 of IS 617 with2mm thick bimetallic liner and all tests shall conform to IS:617
c	For connecting G.I wire	Galvanized mildsteel shield
d	i) bolts, nuts & Plain, washers	i)Electrogalvanized for sizes below M12, for others hot dip galvanized.
	ii)Spring washers for items 'a' to 'c'	ii)Electro galvanized mild steel suitable for at-least service condition-3 as per IS:1573

Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

Where copper to aluminum connections are required, Bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Contractor.

Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of work.

All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.

Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp / connector, except on the hardware.

Buffing of clamp/ connector shall be done for 132kV & above class.

3.1.12 Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of IS:4800. Polyester enamel shall not be used. Double cotton cover, if used, shall be suitably covered to ensure that it does not come in contact with oil. The secondary winding enamel insulation shall be of class 'H' type.

3.1.13 The temperature rise on any part of equipment shall not exceed the maximum temperature rise mentioned below under the conditions specified in test clauses. The permissible temperature rise indicated below is for a maximum ambient temperature of 50 deg.C.

Sl. No.	Nature of the part or of the liquid	Maximum value of	
		Temperature (deg.C)	Temp. rise at a max. ambient air temp. not exceeding 50 deg. C (deg.C)
1.	Contacts in air, silver-faced copper, copper alloy or aluminium alloy (see notes (i) and (ii))	105	55
	Bare copper or tinned aluminium alloy.	75	25
2.	Contacts in oil:		
	Silver-faced copper, copper alloy or aluminum alloy (see note ii)	90	40
	Bare copper or tinned aluminum alloy	80	30
3.	Terminals to be connected to external conductors by screws or bolts silver faced (see note iii)	105	55
	Bare	90	40
4.	Metal parts acting as springs	-----(See note iv)-----	
5.	Metal parts in contact with insulation of the following classes:		
	Class Y :(for non-impregnated materials)	90	40
	Class A :(for materials immersed in oil or impregnated)	105	55
	Class E : in air	120	70
	in oil	100	50
	Class B : in air	130	80
	in oil	100	50
	Class F : in air	155	105
	in oil	100	50
	Enamel : oil base	100	50
	synthetic, air	120	70

Sl. No.	Nature of the part or of the liquid	Maximum value of	
		Temperature (deg.C)	Temp. rise at a max. ambient air temp. not exceeding 50 deg. C (deg.C)
6.	Any part of metal or of insulating material in contact with oil except contacts	100	50
7.	Oil	90	40

Note: i) When applying the temperature rise of 55 deg.C, care should be taken to ensure that no damage is caused to the surrounding insulating materials.

ii) The quality of the silver facing shall be such that a layer of silver remains at the point of contact after the mechanical endurance test. Otherwise, the contacts shall be regarded as "bare".

iii) The values of temperature and temperature rise are valid whether or not the conductor connected to the terminals is silver-faced.

iv) The temperature shall not reach a value where the elasticity of the material is impaired. For pure copper, this implies to a temperature limit of 75 deg.C.

3.1.14 The 220 kV, 132 kV Instrument Transformers shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges, in factory as well as at site. Provision shall be made of a screw on cap for solid and secured earthing of the test tap connection, when not in use. A suitable caution plateshall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and necessity of its solid Earthing as per prescribed method before energizing the Instrument Transformer.

Test procedure and connection diagram for tan delta measurement shall be engraved on stainless steel plate and affixed inside of secondary terminal cover/at any convenient place

A Partial discharge Test clause 5.1.2.2, 8.2.2.2 of IEC 60044-1

a) Measurement at highest system voltage Um for which limiting value is 10 Pc
b) Measurement at 1.2 Um/√3 for which limiting value is 5 Pc.

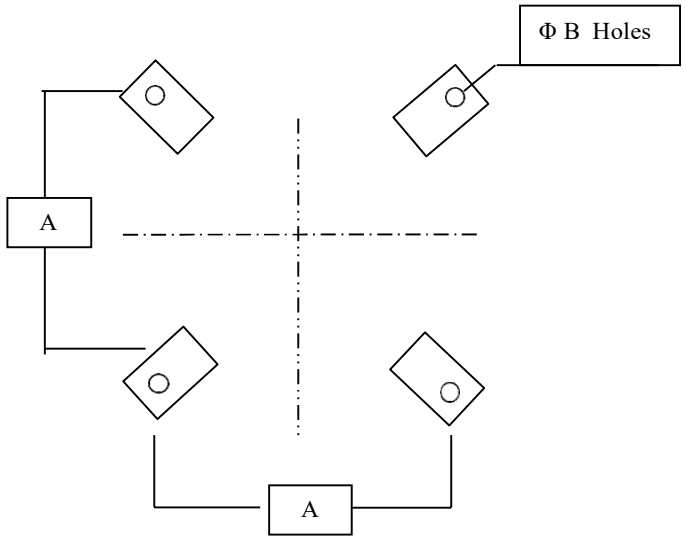
B. Tan Delta Test Clause 5.12.4 of IEC 60044-1

Maximum Limiting value $5x10^{-3}$
Measuring value to be 10 kV to Um/√3

The value of tan delta at 10kV measured at field during pre-commisioning will be reference value.

The tan delta of new CTs/PTs should not be more than 0.5%. Tan delta value of instrument transformers at factory/site should not be more than 0.5% at rated voltage. If tan delta value of instrument transformers while in service exceeds the prescribed limit of 0.7% within guarantee period, it will be considered as failure within guarantee period (Tan delta & capacitance test of instrument transformers shall be measured at 10KV at site) and shall be replaced free of cost by bidder/manufacturer.

3.1.15 . CT/PT/CVT mounting details



A	B	Voltage level
600mm x 600mm	4 Holes of Dia 24 mm.	220kV
450mm x 450mm	4 Holes of Dia 20 mm.	132kV
350mm x 350mm	4 Holes of Dia 20 mm.	33kV

3.2.1 PERFORMANCE GUARANTEE :

The equipment offered shall be guaranteed for satisfactory performance for a period of **60 months from the date of satisfactory commissioning.** The equipment found defective/failed within the above guarantee period shall be replaced/re-paired by the Manufacturer free of cost within one month of receipt of intimation. Transportation of failed /defective instrument transformer to the manufacturer's works shall be arranged by bidder/manufacturer & the cost for the same shall be borne by bidder/manufacturer. If the defective/failed equipment are not replaced/ repaired as per the above guarantee clause, TSTRANSCO shall recover an equivalent amount plus 15% supervision charges from any bill of the Manufacturer.

3.2.2 Defect Liability: The actions required to be taken by contractor in case of defects observed in CT/ PT / CVT of ratings 145kV & above during the warranty period (FIVE YEARS) (defect liability period) shall be as per enclosed Annexure-VII of this specification. Further, the replaced/repaired/refurbished equipment (or part of equipment) shall have Five (5) years warranty without prejudice to contractual warranty period (defect liability period).

3.2.3 **Terminal blocks and wiring:**

Terminal blocks shall be 1100V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The lugs for termination shall be of tin plated copper.

There shall be a minimum clearance of 150 mm between the First/bottom row of terminal block and the associated cable gland plate and the clearance between two rows of terminal blocks shall be a minimum of 100 mm.

4.0 CURRENT TRANSFORMERS

4.1 STANDARDS:

The current transformers and associated accessories shall conform to the latest issues/amendments of standards (IEC: 61869 (Part 1 & 2) / IS: 16227 and the standards given below, except to the extent explicitly modified in the specification.

Sl. No.	Standard No.	Title
1.	IS-16227 (Part 1 & 2)	Instrument Transformers
2.	IS:2165	Insulation Co-ordination for equipment of 100 kV and above.
3.	IS:2705	Current Transformers (I to IV)
4.	IS:2099	High voltage porcelain Bushings
5.	IS:3347	Dimensions of porcelain transformer bushings.
6.	IS:2071	Method of High Voltage Testing.
7.	IS:335	Insulating oil for transformers and switch gears
8.	IS:2147	Degree of protection provided by enclosures for low voltage switch gear and control.
9.	IEC-185	Instrument Transformers.
10.	IEC-270	Partial Discharge Measurement.
11.	IEC-44(1)	Current Transformer measurement of PDs & Tan Delta.
12.	IEC-171	Insulation co-ordination.
13.	IEC-60	High voltage testing techniques
14.	IEC-8263	Method for RIV test on high voltage insulators
15.	Indian Electricity Rules 1956.	
16.	Latest CBIP Manual for Sub-station	

Reference Abbreviation	Name and Address
IEC	International Electro Technical Commission, Bureau central de la commission, Electro Technique international,1, Rue devereimbe Geneva. , Switzerland
IS	Indian standard, Bureau of Indian Standards, Manak Bhavan,9, Bahadur shah Zafar Marg, New Delhi- 110 002.
BS	British Standards, British Standards Institution, 101, Pentonnvilla Road, N -19 - ND - UK.

4.1.1 In case equipment conforms to other international standards which ensure equal or better performance than that specified under clause 2, then the English version of such standards or the relevant extracts of the same shall be furnished with the bid and the salient features of comparison shall be brought out separately in additional information schedule.

4.2. PRINCIPAL PARAMETERS:

The Current Transformers shall conform to the following specific parameters.

Sl. No.	**Item**	**Specification**		
		220 kV	**132 kV**	**33 kV**
1.	Type of Installation	Single phase, dead or live tank oil filled hermetically sealed and outdoor type		Single Phase live tank oil filled hermetically sealed/dry type(polycrete)
2.	Type of mounting	---------- Pedestal Type ----------		
3.	Suitable for system Frequency	----------50 Hz+/- 5%----------		
4.	Highest System voltage (kV rms)	245	145	36
5.	Current Ratio A/A	See Annexure III		
6.	Ratio taps	----------On secondary side----------		
7.	Method of earthing	----------Effectively grounded neutral system---------		
8.	Rated continuous thermal current (A)	----------120% of rated current----------		
9.	Acceptable limit of temperature rise above the specified ambient temperature for continuous operation at rated current	--------As per IEC 16227/IEC 61869 Part 1 & 2------		
10.	Acceptable partial discharge level at 1.1 times the rated voltage	---------- As per Technical Clause No.3.1.14 (A)---------- only. -		Applicable for dry type CT(Polycrete)

11. 1.2/50 microsecond lightning impulse withstand voltage (kVp)	1050	650	170
12. 1 minute dry power frequency withstand voltage for primary winding (kV rms)	460	275	70
13. 1 minute dry Power frequency over-voltage withstand voltage for secondary winding (kV rms)	3	3	3
14. in. total creepage distance of porcelain housing (mm) *	6125	3625	900
15. Rated short time withstand current for 1 second duration (kA rms)	50	40	31.5
16. Rated dynamic withstand current (kAp)	125	100	78.75
17. Type of Insulation	----------Class A ----------		
18. Maximum Radio Interference Voltage for any frequency between 0.5 MHZ to 2.0 MHZ inall positions (micro volts)	1000 micro volts. (at 156 kV rms)	500 micro volts (at 92 kV rms)	NA
19. Seismic acceleration (horizontal)	0.3g		

* The values indicated are for specific creepage of 25mm/kV. In case of specific creepage of 31mm/kV is specified, the Minimum creepage distance values shall be considered proportionately.

4.3 The current transformer shall be of live/dead tank (Hair Pin design) for 220kV and 132kV CTs and live tank for 33kV CTs. The CTs shall be so designed/ constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position if the transport limitations so demand. If thedesign is Live tank, the primary shall be Bar type and for Dead tank only hair pin designis allowed.

In case of inverted type (Live Tank) current transformers, the manufacturer shall meet following additional requirements:

i. The primary conductor shall preferably be of bar type meeting the desired characteristics.
ii. The secondary's shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
iii. The lowest part of the insulation assembly i.e. insulation at neck shall be properly secured to avoid any risk of damage due to transportation stresses.
iv. The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly & top dome.
v. Bellows made of stainless steel shall be used at the top for hermetic sealing of CT.
vi. Bidder/Manufacturer shall recommend whether any special storage facility is required for spare CT.

4.4 For all current transformers, stainless steel metal bellows shall be provided for compensation of oil volume variation. Rubber diaphragms shall not be permitted for this purpose. The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.

4.5 The current transformer secondary terminals shall be brought out in a weather proof terminal box. For terminating secondary connections from windings, molded oil-resistant Epoxy cast resin terminal cover should be used. **"O Rings"** should be as per clause 3.1.6.2, 3.1.6.3. The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade, PVC insulated, PVC sheathed multi-core stranded copper conductor cable. Suitable cable glands for 6Cx2.5 Sq.mm Copper Cables – 3 Nos. for 145kV CT and 5 Nos. for 245kV CT shall be provided.

The terminal boxes shall be perpendicular to the primary terminal P1 & P2. There should be separate terminal box for the dedicated metering core and should be provided with proper sealing. The terminal box shall be dust, vermin proof. The terminal box shall be provided with hinged type door and also with bolts & nuts on four corners. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools. In addition to CT secondary existing terminals one extra set of secondary terminals shall be brought out on top ofthe original terminals to avoid direct tapping of original terminals to avoid leakage of oil.

4.6 Polarity shall be indelibly marked on each primary and secondary terminal. Facility shall be provided for short circuiting and grounding of the current transformer secondary terminals inside the terminal box.

4.7 The current transformer shall be provided with a rating plate with dimensions and markings as per IS:16227/ IEC:61869. The markings shall be punched and not painted.

4.8 The current transformer shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. Oil filling and/or oil sampling cocks, if provided to facilitate factory processing, should be permanently sealed before dispatching the current transformer. The method adopted for hermetic sealing shall be described in the offer.

4.9 The castings of base, collar etc., shall be die cast and tested before assembly to detect cracks and voids if any.

4.10 The Instrument security factor of metering core shall be less than 5 for all ratios. This shall be demonstrated on all the ratios of the metering core, in accordance with procedure specified in relevant standards. If any auxiliary CTs / reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/ reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired up to the terminal blocks.

4.10.1 Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores. The rated extended primary current shall be 120% of rated primary on all cores of the CTs as specified.

4.10.2 The Current Transformer, characteristics, shall be such as to provide satisfactory performance over burdens ranging from 25% and 100% of rated burden over a range of 1% to 120% of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs at 100% of rated current.

4.11 **Core**: The core shall be high grade non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over current voltage. Core lamination shall be of Cold Rolled Grain Oriented (CRGO) silicon steel or other equivalent alloys. Micro(μ) metal or nano-crystalline core can also be used for metering cores. All the cores may be continuous without any air-gap. The area of cross-section of the core and flux density at rated primary current and rated burden shall be consistent with the required characteristics of CTs. The cores shall be carefully annealed and bonded after they are wound, to relieve the stress during winding.

All the protection cores shall be able to produce undisturbed secondary current under transient conditions at all ratios.

4.12 **Winding :**The main insulation for the winding shall consist of paper and oil system which will possess high mechanical strength, superior electrical withstand properties and good ageing qualities to ensure long trouble free life for the CTs . The windings shall have high mechanical strength to withstand short-circuit stresses.

4.13 **Primary Winding:** The Bidder shall furnish in his offer detailed calculations for selection of winding cross-sections.

For 33kV CTs: For 33kV CTs primary must be a single copper rod of circular cross section of Diameter 30 mm up to 800 amps and single 5**0 mm** diameter rod for current rating above 800Amps. The secondary connections from the secondary winding shall be of Teflon insulation. The insulators for primary studs/ terminals shall be of FRP or Epoxy cast resin. **The continuous and extended rating current density for primary should not exceed 1.65Amps / Square mm.** The short circuit current density should meet relevant standards.

For 132kV and above: Primary winding shall consist of Rigid primary of suitable design. Unavoidable joints in the Primary winding shall be of welded type. The winding shall be Hair pin type for dead tank and Rigid bar type for Live tank. The conducting material for primary winding may consist of electrolytic high conductivity rigid copper rod or rigid Aluminum tube /flat of sufficient area of cross-section to cater for the guaranteed short time as well as continuous thermal current rating. Flexible copper/Aluminum conductor as primary is not allowed. The bidder may offer CTs having bar type primary with inverted arrangement of construction if considered more appropriate. The details of such welded joints shall be indicated in the drawings submitted with the offer. The design density for short circuit current as well as conductivity of the metal used for primary winding shall meet the requirement of IS 16227/IEC 61869. **The continuous and extended rating current density for primary winding with copper conductor should not exceed 1.65 Amps/Sq.mm and with aluminium conductor should not exceed 0.8Amps/Sq.mm**. The short circuit current density should meet relevant standards..

4.14 **Secondary Windings:**
Suitably insulated copper wire of high conductivity electrolytic grade shall be used for secondary windings. Type of insulation used shall be described in the offer. For multi ratio design, suitable tappings shall be provided on the secondary winding only. Primary reconnection to achieve different ratios on secondary is not acceptable.

4.15 The exciting current of the current transformer shall be as low as possible. The Bidder shall furnish along with his offer the magnetization curve(s) for all the core(s).

4.16. Primary Terminals:

132kV and Above Voltage level: For ratings above 800 Amps, the primary terminals shall be of one number 40 mm Diameter copper rod or Aluminum pad of sufficient size. For ratings equal to and below 800 Amps, the primary terminals shall be of 30 mm Diameter copper rod or 40mm Aluminum pad/rod. The primary terminals shall be of heavily tinned electrolytic copper or aluminum alloy of 99.9% conductivity. The minimum thickness of tinning shall be 15 microns.

For 33kV CT: The dimensions should be as per clause 4.13. The surface of the terminal outside the tank shall be tinned. The minimum thickness of tinning shall be 15 microns.

4.17. Secondary Terminals:

The secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box. Secondary terminal studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum outside diameter of the studs shall be 6mm. A length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between centers of the adjacent studs shall be at least 1.5 times the outside circum dia of the nuts.

4.18. Explosion

The CT shall be designed so as to achieve the minimum risks of explosion in service. The Bidder / Manufacturer shall bring out in his offer, the measures taken to achieve this.

4.19. Terminal box/Marshalling box

Marshalling shall generally conform to & be tested in accordance with IS-5039 / IS-8623, IEC-439 and shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. Facilities shall be provided at terminal blocks inthe marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals. The wiring diagram plate for the interconnections of the three single phase CTs shall be provided inside the marshalling box.

TECHNICAL SPECIFICATION FOR MARSHALLING BOXES FOR 33kV CTs
(Not in manufacturer scope)

The box should be made of 2 mm thick Galvanized M.S. Sheet of size 750x400x150mm with hinged type door, vermin proof and weather proof. Rubber beading has to be provided around the door. Necessary brackets on the back side of the box should be provided for mounting on the structures. Doors of the box should be provided with panel type look. The top portion of the box shall be slanting so that rain water will fall away easily. Two rows having 20Nos. terminals in one and 14Nos. in other should be provided in the box. The terminals should be of disconnecting and testing type (Type CDTTS of 'connected make'.) Three Nos. holed (Half punched) suitable for 6x2.5 sq.mm Copper cable and 3 Nos. holes (half punched) suitable for 4x2.5 Sq.mm copper cable should be provided at the bottom to take the cables into the box. Suitable cable glands should be supplied. Terminals in the Marshalling box should have facility for easy earthing, shorting, isolating and testing. 2 Sets of Earthing stud of ½'' dia with suitable nuts, flat and spring washers are to be provided.

4.21 220kV, 132kV Current transformers shall be suitable for high speed auto reclosing.

4.22 TESTS :

4.22.1 Type Tests for CTs : shall be as per IEC61869-1 & 2 / IS16227 (part1)

Current Transformers offered in the bid shall be fully type tested as per the relevant standards. The type tests must have been conducted not earlier than Ten years from the date of bid opening. The Bidder shall furnish two sets of the following type test reports as per latest IEC 61869 / IS 16227 along with offer.

TYPE TESTS:-

i) Determination of errors
ii) Short-time Current test
iii) High Voltage Power Frequency wet withstand test on primary/secondary windings(3kV/5kV)
iv) Lightning Impulse withstand voltage test
v) Temperature rise test.
vi) IP-55 Test on secondary Terminal Box.
vii) Instrument Security Factor (ISF) Test.
viii) RIV Test.

In addition to type test reports, the manufacturer has to furnish test reports for the following Special Tests for 145kV and above voltage rating:

(i) Seismic withstand test.
(ii) Mechanical Test on primary Terminals.
(iii) Internal arc fault test for Porcelain Housed CT (If manufacturer doesn't have internal arc type test report for the same voltage class CT as the submitted design, applicability report along with type test report conducted on other voltage class CT may be acceptable)
(iv) Multiple chopped impulse test with the application of 600 chopped impulses
(v) Thermal stability test , i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit (not applicable for SF6 filled CT).
(vi) Thermal co-efficient test i.e. measurement of tan-delta as a function of temperature (at ambient and between 80°C & 90°C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um/√3) (not applicable for SF6 filled CT).
(vii) Transmitted over voltage test.
(viii) Corrosion test

Lightning Impulse Test, switching Impulse Voltage test and High Voltage power frequency wet withstand voltage Tests should have been carried out on the same current transformer. After the current transformers have been subjected to lightning Impulse Test, and High Voltage power frequency wet withstand voltage tests, these must have been subjected to all the routine tests as per relevant standards.

In case of non-availability of test facilities at CPRI/ERDA for thermal stability test and Temperature co efficient test, In-house reports at Manufacturer's works with NABL accredited lab / 3rd party NABL lab test reports will be considered.

4.22.2 ROUTINETESTS:

All routine tests as per IS16227/IEC61869 are to be carried out by the manufacturer, in addition to the following tests

(i) Oil leakage test.
(ii) Measurement of tan delta at 0.3, 0.7, 1.0 , 1.1 Um/√3 and 10kV.

4.22.3 ACCEPTANCE TESTS:

For 220kV &132kV : The manufacturer should have in house NABL accredited lab for conducting below mentioned acceptance tests. All the equipment used for testing should have valid calibration at the date of testing. If the in house lab is not NABL accredited, then all FAT shall be done in third party NABL labs in presence of TSTRANSCO representative, without any additional financial implication to TSTRANSCO.

Current Transformer should have been type tested and shall be subjected to routine tested and called for inspection in accordance with relevant IEC.

The following are the Factory acceptance tests as per IS 16227/IEC 61869 (Part 1 & 2) and as per TSTransco requirement.

i) High voltage power frequency dry withstand test on Secondary Winding(5kV)
ii) High Voltage Power frequency dry withstand test on primary winding
iii) Over-voltage inter turn test
iv) Oil leakage test
v) Measurement of capacitance and tan-delta before and after HV test at 0.3,0.7,1.0 and 1.1 Um/√3 and also at 5kV, 10kV. Maximum Limiting value of Tan-Delta is 5 x10-3 and variation of Tan Delta values at various voltages shall not exceed 0.0005.
vi) Measurement of partial discharge shall be carried out.
vii) Temperature coefficient test.
viii) Thermal stability test.
ix) Verification of Terminal marking, dimensions and creepage distance.
x) Measurement of secondary winding resistance.
xi) Determination of Ratio, Accuracy Test.
xii) Instrument Security factor (ISF) Test.
xiii) Knee point voltage test.
xiv) IR Values measurement Test.(The IR value measured at factory will be reference value at site).

Note: Special Tests of 'Temperature Co-efficient (TC)' and 'Thermal Stability (TS)' shall be conducted on one CT only for every lot (i.e., TC on one CT and TS on another CT out of the offered lot for inspection). This test is applicable for 132kV & above CTs. The test should be done on highest current ratio of the offered CT rating.

5.0 CAPACITOR VOLTAGE TRANSFORMERS :

5.1. STANDARDS:

Unless otherwise specified elsewhere in this specification the rating as well as performance and testing of the Capacitor voltage transformers and associated accessories shall confirm to the latest issues/amendments of standards available at the time of placement of order of all the relevant standards as listed hereunder.

Sl. No.	Standard No.	Title
CAPACITOR VOLTAGE TRANSFORMERS		
1.	IEC: 61869 (Part 1 & 5) / IS: 16227	Instrument Transformers
2.	IS:3156 (PART-IV)	Capacitor Voltage Transformers
3.	IS:2099	High Voltage porcelain bushings
4.	IS:2071	Method of High Voltage Testing
5.	IS:335	Insulating oil for transformers and switchings.
6.	IS:2165	Insulation Co-ordination for equipment of 100 kV and above.
7.	IEC:186	Voltage Transformers :-Chapter –III Capacitor Voltage Transformers:- Chapter – IV
8.	IEC:186 A	First supplement to IEC Publication 186
9.	IEC-270	Partial Discharge Measurement..
10.	IEC-171	Insulation co-ordination.
11.	IEC-358	Coupling capacitor divider.
12.	IEC-60	High Voltage Testing Techniques.
13.	IS: 9348	Coupling capacitors and capacitor dividers.

Reference Standards	Name and Address
IEC	International Electro Technical Commission, Bureau centraldela commission, Electro Technique International, 1, Rue de vereimbe Geneva. , Switzerland
ISO	International Organizations for Standardization Danish Board of Standardization, Aurehoegvaj – 12 DK – 2900, Heelprup DENMARK.

IS	Indian standard, Bureau of India Standards Manak Bhavan, 9, Bahadur shah Zafar Marg, New Delhi- 110 002. INDIA.

5.1.1 Equipment meeting with the requirement of other authoritative standards which ensure equal or better performance than the standards mentioned above, shall also be considered. When the equipment offered by the Bidder conforms to other standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule. Four copies of such standards with authentic translation in English shall be furnished along with the offer.

5.2 PRINCIPAL PARAMETERS:

The Capacitor Voltage Transformers shall conform to the following specific parameters.

Sl. No.	**Item**	**S p e c i f i c a t i o n**	
		132 kV	**220 kV**
	CAPACITOR VOLTAGE TRANSFORMERS:		
1.	Type of Installation	Single phase, oil filled hermetically sealed and outdoor type	Single phase, oil filled hermetically sealed and outdoor type
2.	Type of mounting	Pedestal Type	Pedestal Type
3.	Suitable for system Frequency	50 Hz +/- 5%	50 Hz +/- 5%
4.	Highest System voltage (kV rms)	145	245
5.	Voltage Ratio		
	(i) Rated primary Voltage (kV r.m.s)	132/√3	220/ √3
	(ii) Secondary Voltage(Volts) (For metering & protection)	110/ √3	110/ √3
6.	Rated output burden Secondary (VA)		
	Winding - I	30 VA	30 VA
	Winding – II	30 VA	30 VA
	Winding - III	---	30 VA

Sl. No.	Item	Specification 132 kV	220 kV
7.	Accuracy Class		
	Winding – I	0.2	0.2
	Winding – II	3P&0.5	3P& 0.5
	Winding –III	--	3P& 0.5
8.	Method of earthing the system	Effectively earthed	Effectively earthed
9	1.2/50 microsecond lightning impulse withstand voltage(kvp)	650	1050
10)	1 minute dry Power frequency withstand voltage for Primary winding (kV rms)	275	460
11)	Min. creepage distance of porcelain housing (mm)	3625	6125
12)	Rated Voltage factor	1.2 Continuous 1.5 for 30 seconds	1.2 continuous 1.5 for 30 seconds
13)	Limits of voltage errors and Phase displacement	Accuracy class / Percentage Voltage error / Phase displacement in minutes	
	a) Metering 0.2	± 0.2	± 10
	b) Metering 0.5	± 0.5	± 20
	c) Protection 3p	± 3	± 120
14.	Rated total capacitance (pf)	4400+10% - 5%	4400 +10% - 5%
15.	Acceptable limit of variation of total capacitance over the entire carrier frequency range	+ 50 % & -20 % of the rated capacitance	+ 50 % and – 20% of the rated capacitance
16.	Equivalent series resistance over the entire carrier frequency range (ohms)	<40	<40

17.	Stray capacitance and stray conductance of low voltage terminal over the entire carrier frequency range	As per IEC- 350	As per IEC-350
18.	Standard reference range of frequency for which accuracies are valid	96% to 102 % for protection 99% to 101% metering	96% to 102% for protection 99% to 101% metering
19.	1 minute power frequency withstand voltage :		
	i) Low voltage terminal (HF) and earth terminal (kV r.m.s)	3	3
	ii) Withstand voltage for secondary winding (kV r.m.s)	3	3
20.	Partial discharge level at rated voltage for capacitance divider (pico coulombs)	< 10	< 10
21.	Maximum Temperature rise over ambient of 50 deg.C	As per IEC – 186	As per IEC – 186
22.	Rated total thermal burden (Simultaneous)	60 VA	90 VA
23.	Seismic acceleration (Horizontal)	0.3 g	0.3 g
24.	Type of insulation	Class A	Class A

5.3 The Capacitor voltage transformer is required for protection , metering, telemetering and telecontrol purposes.

5.4 The capacitor voltage divider of the capacitor voltage transformer shall be mounted in shedded, oil filled porcelain bushing. The electro-magnetic unit consisting compensating reactor, intermediate transformer, protective and damping devices etc., shall be mounted in a hermetically sealed metal enclosure, which shall also be used as a mechanical support for the capacitor voltage divider. The terminals of the secondary windings of the electromagnetic units shall be brought out in a separate, weather proof terminal box, which shall be properly mounted on the wall of the metal enclosure of the electromagnetic unit. The terminal box shall be dust, vermin proof. The terminal box shall be provided with hinged type door and also with bolts & nuts on four corners. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools. Suitable arrangement shall be provided for drying of air inside the terminal box

5.5. The capacitor voltage divider shall capable of being used over a wide carrier frequency bandwidth. The value of capacitance shall be suitably chosen for reliable wide band carrier coupling and shall be as per the values indicated in clause 5.1. The reactance of the teed branch of the CVT shall be adjusted to minimize carrier loss. With carrier frequency coupling device connected to the earth lead of the intermediate coupling capacitor, the accuracy of the electromagnetic voltage transformer unit shall remain within the specified limits.

5.6 Volumetric variations of the insulating oil inside the capacitor voltage divider unit shall be suitably compensated. The arrangement provided for this purpose shall be clearly described in the offer. Each unit of the capacitor voltage divider shall be hermetically sealed.

5.7 The oil volume variation in metal enclosure of the electromagnetic unit shall be counter balanced by a suitably dimensioned gas cushion.

5.8 Electromagnetic Unit / Base Housing :

5.8.1 The enclosure housing the Electromagnetic unit shall be made of aluminium which will also serve as a mounting base for the Capacitor stack and a housing for carrier accessories.

5.9 PRIMARY WINDING:

The primary winding shall be of suitably insulated electrolytic copper wire. Type of insulation used shall be described in the offer. A carrier frequency choke shall be provided in series with the primary winding to prevent the loss of signal.

5.10 SECONDARY WINDING:

Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. Type of insulation used shall be described in the offer. Each core of secondary winding shall be protected by two sets of HRC fuses in parallel.

5.11 The Secondary terminals shall be brought out in a weather proof terminal box. The HRC fuses meant for protection of secondary winding shall also be located in the terminal box. The terminal box shall be provided with removable gland plate and glands suitable for 1100 voltage grade, PVC insulated, PVC sheathed multicore stranded copper conductor cable. The dimensions of the terminal box and its openings shall be adequate to enable easy access and sufficient working space for use of normal tools. Polarity shall be indelibly marked on each of the secondary terminals in the terminal box.

5.12 SECONDARY TERMINALS:

Secondary winding terminal studs shall be provided with at least three nuts, plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum outside diameter of the studs shall be 6mm. A length of at least 15 mm shall be available on the studs for inserting the leads.

5.13. The capacitor voltage transformer shall be provided with a rating plate with dimensions and markings as per IEC 61869 (Part- V). The markings shall be punched and not painted.

5.14 TESTS:

5.14.1. Type Test for CVTs:

CVTs of each voltage class offered in the bid shall be fully type tested as per the relevant standards. The type tests must have been conducted not earlier than Ten years from the date of Bid opening . The Bidder shall furnish two sets of the following type test reports as per IEC 61869-Part 1 & 5 & IEC 60358 along with offer.

i. Temperature-rise test.
ii. Lightning impulse test on complete CVT. (or Separately on capacitor divider unit & EMU)
iii. Ferro resonance test.
iv. Transient response test.
v. Accuracy test.
vi. Partial Discharge Voltage.
vii. Visual Corona Extinction test. (Minimum 156kV as per CEA guidelines)
viii. Seismic withstand test.
ix. High frequency capacitance and equivalent series resistance measurement (as per IEC-60358).
x. Stray capacitance and stray conductance measurement of the low voltage terminal (as per IEC-60358).
xi. IP.55 test on Sec. Terminal box.
xii. Short circuit withstand capability test
xiii. Mechanical loading test on Primary Terminal.
xiv. Wet Test for outdoor Type Transformer.
xv. Electromagnetic compatibility test (RIV).
xvi. Measurement of Capacitance and Tan delta at 30 %, 70%, 100% and 110% of Um/√3 and at 5KV,10 kV also before and after HV test.
xvii. Enclosure tightness test at ambient temperature.
xviii. Determination of Temperature co-efficient.
xix. Type tests for carrier frequency accessories.

The offers received without these type test reports shall be treated as Non-Responsive.

5.14.2 Acceptance and Routine Tests:

For 220kV &132kV : The manufacturer should have in house NABL accredited lab for conducting below mentioned acceptance tests. If the in house lab is not NABL accredited, then all FAT shall be done in third party NABL labs in presence of TSTRANSCO representative, without any additional financial implication to TSTRANSCO.

All acceptance and routine tests for Instrument Transformers as stipulated in the relevant standards and partial discharge test and tan delta tests shall be carried out as per Technical clause No.3.1.14 (A) and (B), shall be carried out compulsorily by the Bidder in the presence of Purchaser's representative.

All routine tests as per IS16227/IEC61869 are to be carried out by the manufacturer, in addition to the following tests

(iii) Oil leakage test.
(iv) Measurement of tan delta at 0.3, 0.7, 1.0 , 1.1 Um/√3 and 10kV.

The following are the acceptance tests as per IS 3156/IEC 61869-1&5 and as per TSTRANSCO requirement.

i) Measurement of Capacitance and Tan Delta before and after HV test at 0.3, 0.7, 1.0, 1.1Um/√3 and also 5KV, 10KV. **Maximum Limiting value of Tan-Delta is <5x10^{-3}**

Note: Variation of tan delta values at various voltages shall not exceed 0.0005.

ii) One Minute power frequency dry withstand test on Primary winding

a) On Capacitor divider unit (dry).

b) On NHF terminal of capacitor divider unit.

c) Neutral lead of IVT of EMU.

iii) High voltage power frequency dry withstand test on Secondary winding.

iv) High voltage power frequency dry withstand test between sections.

v) Tightness test on capacitor divider.

vi) Induced high voltage test on EMU.

vii) Ferro Resonance Test.

viii) Oil leakage test.

ix) Measurement of Partial discharge at 1.2Um/√3 and at Um.

x) Verification of Polarity test, Terminal markings, Dimensions and Creepage distance

xi) Determination of Ratio, Accuracy

xii) IR values measurements test.

xiii) Determination of Temperature co-efficient on 1 No. Sample per lot.

6.0. POTENTIAL TRANSFORMERS :

The PTs covered by this specification shall comply with the latest issue of IS-16227 -1&3 or IEC – 61869-1&3 except where specified otherwise. The bushing shall be of single piece. PTs with cores mounted at the top or middle of the bushing are not acceptable. Bushings with metallic joints in the middle are also not acceptable. The oil used for the PTs shall conform to the requirements of IS-335 of latest edition or latest standard. The PTs shall be supplied with first filling of oil. The bushings of PTs shall conform to the IS-2099 & IEC 60137 of latest edition or latest standard.

6.1. PRINCIPAL PARAMETERS :

The Voltage Transformers shall confirm to the following specific parameters

Sl. No.	Item		Specification 220kV	132kV	33kV
a)	Type and self cooled.	:	Outdoor, Single phase, oil immersed		
b)	Mounting of tank	:	-- Bottom tank --		
c)	Nominal system voltage	:	220kV	132kV	33kV
d)	Highest system voltage	:	245kV	145kV	36kV
e)	Earthing of system	:	Effectively grounded neutral system		
f)	Frequency	:	-- 50 C/S –		
g)	Insulation level (primary)	:	460 kVrms	275 kVrms	70 kV rms
h)	One minute power frequency withstand test voltage	:	-- 3 kV rms -- (Secondary)		
i)	Impulse withstand voltage(peak)	:	1050 kV	650 kV	170kV
j)	Rated Voltage Factor	:	1.2 times continuous and 1.5 for 30 seconds.		
j)	Minimum creepage distance of	:	6125mm	3625mm	900mm
	i) Bottom-most portion of the bushing: at a height of (the structure design to meet this requirement shall be given by the tenderer		2500 mm	2500mm	
k)	i)Primary and secondary core details:		The VTs are intended for use on 3 phase system. These shall be of single phase with primary suitable for phase to earth connection. The primary voltage is 220/√3kV, 132/√3kVand 33/√3kV. The secondary core details are as indicated below:		

		--- 220 kV &132 kV ---			--- 33 kV	
Secondary winding	:	I	II	III	I	II
Secondary voltage	:	110 / √3 volts			110/√3 volts	
Class of accuracy	:	0.2	3P&0.5	3P&0.5	0.2	3P&0.5
Rated burden VA (simultaneous)	:	50	50	50	50	50

6.2 The terminal box shall be provided with hinged type door and also with bolts & nuts on four corners. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools.. The bushings of PTs shall conform to the ISS-2039 of latest issue.

6.3 Type Tests for PTs: PTs of each voltage class offered in the bid shall be fully type tested as per the relevant standards. **The date of type tests will not be earlier than ten years as on the date of bid opening.** If any change in design was made latest type tests shall be furnished along with approved drawing. The Bidder shall furnish two sets of the following type test reports as per IS-16227 -1&3, IEC 61869-1 & 3 along with offer.

i) Temperature rise test.
ii) Lightning impulse test.
iii) High voltage power frequency wet withstand voltage test.
iv) Determination of errors.
v) IP.55 test on Sec. Terminal box.
vi) Short circuit withstand capability test.

For 145kV and above voltage rating : In addition to type test reports, the manufacturer has to furnish test reports for the following Tests:

(i) Multiple chopped impulse test with the application of 600 chopped impulses for 145kV and above voltage rating.
(ii) Seismic withstand test.
(iii) Mechanical loading test on primary terminals.

The offers received without these type test reports shall be treated as Non-Responsive.

6.4 Acceptance and Routine Tests:

For 220kV &132kV : The manufacturer should have in house NABL accredited lab for conducting below mentioned acceptance tests. If the in house lab is not NABL accredited, then all FAT shall be done in third party NABL labs in presence of TSTRANSCO representative, without any additional financial implication to TSTRANSCO.

All routine tests as per IS16227/IEC61869 are to be carried out by the manufacturer, in addition to the following tests

(i) Oil leakage test.
(ii) Measurement of tan delta at 0.3, 0.7, 1.0 , 1.1 Um/√3 and 10kV.

The following are the acceptance tests as per IS 3156/IEC 61869 (Part 1 & 3) and as per TSTransco requirement.

i) High voltage power frequency dry withstand test on Secondary Winding (5kV preferably).
ii) High Voltage Power frequency dry withstand test on primary winding.
   a) Separate Source Withstand test.
   b) Induced over voltage withstand test.
iii) Oil leakage test
iv) Measurement of capacitance and tan-delta before and after HV test at 0.3,0.7,1.0 and 1.1 Um/√3 and also at 5kV & 10kV. Maximum Limiting value of Tan-Delta is $<5x10^{-3}$ and variation of Tan Delta values at various voltages shall not exceed 0.0005.
v) Measurement of partial discharge at 1.2 Um/√3 and Um.
vi) Verification of Terminal markings, dimensions and Creepage distance.
vii) Determination of Ratio & Accuracy Test.
viii) IR Values measurement Test.

7 TESTS:

7.1 For CTs: Refer Cl.4.22

7.2.Type Test for CVTs : Refer Cl.5.14

7.3.1. Type Test for PTs

Refer Cl.6.3

7.4 Acceptance and Routine Tests:

All acceptance and routine tests for Instrument Transformers as stipulated in the relevant standards, partial discharge test and tan delta tests etc as detailed in respective sections, shall be carried out compulsorily by the Bidder in the presence of Purchaser's representative.

Immediately after finalization of the program of acceptance/routine testing, the Bidder shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

8. INSPECTION:

i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the Instrument Transformers are being manufactured and the Bidder shall provide Purchaser representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.

ii) The Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangements could be made for inspection.

iii) No equipment shall be dispatched from its place of manufacture unless the equipment has been satisfactorily inspected and tested.

iv) The acceptance of any quantity of the equipment shall in no way relieve the Bidder of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

The bidder shall give 15 days (for local supplies)/ 60 days (in case of foreign supplies) advance, intimation to enable the purchaser to depute his representative for witnessing acceptance and routine tests. All charges in connection with inspection by Purchaser's personnel such as travel, accommodation and incidentals shall be borne by the purchaser

9 QUALITY ASSURANCE PLAN: Refer Clause-3 of Section-I, General

10. DOCUMENTATION:

10.1 All drawings shall conform to International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units only.

10.2 List of Drawings and Documents:

The Bidder shall furnish four sets of following drawings along with his offer:

a) General outline and assembly drawings of the equipment.
b) Graphs showing the performance of equipment in regard to magnetization characteristics.
c) Sectional views showing:
   i) General Constructional Features.
   ii) Materials/Gaskets/Sealing used.
   iii) The insulation of the winding arrangements, method of connection of the primary/secondary winding to the primary/secondary terminals etc.,
   iv) Porcelain used and its dimensions along with the mechanical and electrical characteristics.
d) Arrangement of terminals and details of connection studs provided.
e) Name plate.
f) Schematic drawing.
g) Type test reports of equipment offered.
h) Test reports, literature, pamphlets of the bought out items and raw material.

10.3 The Bidder shall within 2 weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Bidder within reasonable time. The Bidder shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments.
After receipt of Purchaser's approval, the Bidder shall within three weeks, submit 20 prints and two good quality reproducible of the approved drawings for Purchaser's use.

10.4 Adequate copies of contract drawings, acceptance and routine test certificates, duly approved by the Purchaser shall accompany each of the dispatched consignment.

10.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk only.

10.6 Twenty (20) copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English language, for each type and rating of equipment supplied shall be submitted by the Bidder for distribution, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the transformers. The manual shall also contain a set of all the approved drawings, type, routine & acceptance Test reports etc.

10.7 Approval of drawings by the Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and the Purchaser shall have the power to reject any material which in his judgement is not in full accordance therewith.

11 PACKING AND FORWARDING: Refer Clause-4 of Section-I, General

12 QUANTITY AND DELIVERY REQUIREMENTS : Refer Clause-5 of Section-I, General

13 SUPERVISION SERVICES : Refer Clause-6 of Section-I, General

14. MARKING : Refer Clause-7 of Section-I, General

15.0 GUARANTEED TECHNICAL PARTICULARS:

The Guaranteed Technical particulars for the equipment being supplied shall be provided with the Bid as specified in this technical specification at Annexures. The Bids received without guaranteed technical particulars shall be treated as Non-responsive.

ANNEXURE-I

GUARANTEED TECHNICAL PARTICULARS FOR CURRENT TRANSFORMERS

(To be filled in by the Bidder separately for each type and voltage rating)

1. Type of tank/Installation

2. Type of mounting

3. Manufacturer's Name and address and Country of Manufacture

4. Conforming to standard

5. a) i) Primary and Secondary winding made out of (As per clause 4.12,4.13,4.14)

   ii) Primary windings – Design density for short circuit current –
   Conductivity of metal used -

   b) i) Area of cross section of primary winding

   ii) Area of cross section of secondary winding

   c) Material used for providing secondary terminals

6. Rated primary voltage (kV rms)

7. Rated highest voltage (kV rms)

8. Rated frequency (Hz)

9. Rated primary current (A)

10. Rated secondary current (A)

11. Ratio taps (on secondary side only)
12. Type of insulation --Primary winding
    --Secondary winding

13. Seismic acceleration (g) --Horizontal
    -- Vertical
14. RIV at 1.1 x Um/root3 (uv)

15. Tank material and Tank coating (As per clause 3.1.3 & 3.1.4)

16. Hardware exposed to atmosphere (As per clause 3.1.4)

17. Bolts, Nuts and Washers (As per clause 3.1.4)

18. Porcelain housing and it make (Single piece only as per clause 3.1.2)

19. Sealing (Nitrogen gas cushion/Metal bellow as per clause 3.1.7)

20. Instrument security factor (As per clause 4.10)

21. Whether test tap provided (As per clause 4.18)

22. Acceptable limit of temperature

23. Acceptable partial discharge level at 1.1 times the rated voltage

23. a. Dielectric Dissipation factor & its Measured Voltage

24. Rated short time withstand current for 1 sec. duration (kA rms)

25. Rated dynamic withstand current (kAp)

26. Rated continuous thermal current (pu) where pu = rated current

27. 1.2/50 micro-second impulse withstand voltage (kVp)

28. One minute power frequency withstand voltage (kV rms) of primary winding (Dry)

29. One minute power frequency withstand voltage of secondary winding (kV rms)

30. (i) a) Minimum total creepage distance of insulator bushing (mm)

b) Protected creepage of distance of bushing (mm)

30.(ii) Mechanical loading on primary winding terminals – Horizontal
– Vertical

31. Details of Cores Core No. I II III IV V

31.1 Current Ratios A/A ----------

31.2 Output burden (VA) ----------

31.3 Class of accuracy ----------

31.4 Accuracy limit factor ----------

31.5 Min. knee point voltage (kpV) ----------

31.6 Secondary resistance ----------
corrected to 75 deg.C

31.7 Max. exciting current at ----------
20% of knee point voltage
50% of knee point voltage
100% of knee point voltage

31.8 Application ----------

31.9 Core
a) Area of cross section ----------

b) Flux density at rated primary current and rated burden.

32. Weight of oil (Kg.)

33. Total Weight (Kg.)

34. Mounting details

35 Overall dimensions

36. Characteristics (whether graphs enclosed):

a. Ratio and phase angle curves

b. Magnetisation curves

c. Ratio correction factor curves

37. Insulating oil
(a) Type (Paraffinic/Napthenic)
(b) Standard
© Qty. (in Litres or Kg.) (To be mentioned by the manufacturer as per design)
38 Whether all seals are of "O" ring type
39 Whether all "O" Rings are fixed in machined grooves with adequate space for compression
40 Whether the main hollow insulator has the cost iron flanges cemented at both ends
41 Month & Year of Type Tests Conducted

42 Additional Information:

a) "O" ring / Gasket details (Make , Material & Thickness)
b) Details of metallic bellows (Make, Material, Applicable standard)
c) Raw material suppliers (Primary & Secondary)

43 Live terminal to plinth level to be maintained as per General guidelines (CEA – June 2012) for 765/400/220/132kV Substation and Switchyard of Thermal / HydroPower Projects (i.e.,4.8m for 132kV CT, 5.5m for 220kV CT) for 2.7m CPL Structure.

44 Bushing length to be maintained as per General guidelines (CEA – June 2012) for 765/400/220/132kV Substation and Switchyard of Thermal / Hydro Power Projects / Type Tests.

Name of the firm .....

Signature of Bidder.....

Name & Designation & Seal .....

Date .....

ANNEXURE-II

Core Wise Details Of Current Transformers

220 KV CURRENT TRANSFORMERS

1600 - 800 - 500 /1-1-1-1-1-1A

(For Feeders, PTRs, Bus Coupler)

Core No.	Application	Current Ratio	Output Burden VA	Accuracy Class / ALF	Minimum Knee Point (volts)	Max. CT Sec.wdg. Resistance @at 75°C (Ω)	Maximum exciting current at Vk (mA)
1	Main- 1 Line Distance / Line Differential Protection PTR Differential Protection	1600/1	-	PX	1600	8	25
		800/1			800	4	50
		500/1			500	2.5	80
2	Main- 2 Line Distance / Line Differential Protection PTR Over Current & Earth Fault Protection	1600/1	20	PX/5P20	1600	8	25
		800/1			800	4	50
		500/1			500	2.5	80
3	Metering	1600/1	10	0.2s	ISF<=5		
		800/1					
		500/1					
4	Bus -bar Differential Protection -Main	1600/1	-	PX	1600	8	25
		800/1			800	4	50
		500/1			500	2.5	80
5	Bus - bar Differential Protection -Check	1600/1	-	PX	1600	8	25
		800/1			800	4	50
		500/1			500	2.5	80

132 KV CURRENT TRANSFORMERS
1200 - 600 - 400 /1-1-1-1A
(For Feeders, PTRs)

Core No.	Application	Current Ratio	Output Burden VA	Accuracy Class / ALF	Minimum Knee Point (volts)	Max. CT Sec.wdg. Resistance @at 75°C (Ω)	Maximum exciting current at Vk (mA)
1	Line Distance / Line Differential Protection	1200/1	--	PX	1600	6	12.5
		600/1			800	3	25
	PTR Differential Protection	400/1			500	2	50
2	Over Current & Earth Fault Protection	1200/1	20	5P 20	--		
		600/1			--		
		400/1			--		
3	Metering (Panel)	1200/1	10	0.2S	ISF<=5		
		600/1					
		400/1					
4	Metering ** (Interface / Boundary)	1200/1	5	0.2S	ISF<=5		
		600/1					
	** To be provided in separate terminal box with sealing arrangements	400/1					

** The secondaries of the fourth core (0.2S class metering core) shall be terminated in a separate terminal box with provision for sealing (secondary terminal box for 4th core shall be at 90º to P1 and P2 terminals i.e. the 4th core with provision for sealing may be provided on opposite side of terminal box of 1st, 2nd & 3rd core.)

Note : i) The standardization of CTs is not considered for 10/16 MVA PTRs, capacitor banks, specific requirement of LIS & PRLIS for station & pump transformers.

ii) The standard CT ratio for 132kV i.e., 1200-600-400/1-1-1-1A may not be suitable for certain protective relays and exchange of relays may be taken up as per requirement.

iii) As per field requirement, procurement of CTs with any other ratios may be taken up with necessary approvals.

33 KV CURRENT TRANSFORMERS

A. 2000-1000-600-400 A/1-1-1A

(For PTRs)

Core No.	Application	Current Ratio	Output Burden VA	Accuracy Class / ALF	Minimum Knee Point (volts)	Max. CT Sec.wdg. Resistance @at 75°C (Ω)	Maximum exciting current at Vk (mA)
1	PTR Differential Protection	2000/1	--	PX	500	10	16.5
		1000/1			250	5	33
		600/1			150	3	55
		400/1			100	2	82.5
2	Over Current & Earth Fault Protection	2000/1	20	5P 20	--		
		1000/1			--		
	PTR OL & EF/ EL / REF Protection	600/1			--		
		400/1			--		
3	Metering (Panel)	2000/1	10	0.2S	ISF<=5		
		1000/1					
		600/1					
		400/1					

B. 600 - 400 /1-1A

(For 33kV Line Feeders)

Core No.	Application	Current Ratio	Output BurdenVA	Accuracy Class	ALF	ISF
1	Over Current & Earth Fault Protection	600/1	20	5P	20	-
		400/1				
2	Metering	600/1	10	0.2S		<=5
		400/1				

Note :

1. Additional one set of secondary terminals shall be brought on top of the secondary terminals to avoid direct tapping of the terminals.
2. The terminal connectors to be supplied along with the equipment shall be suitablefor both horizontal and vertical take-offs of the conductor.
3. The maximum excitation current at knee point voltage indicated shall be atminimum ratio for PS cores.
4. The instrument security factor for metering core shall be less than five (5) at allratios.
5. The CT ratios shall be achieved through secondary tappings only without any primary reconnection.

ANNEXURE-III

GUARANTEED TECHNICAL PARTICULARS FOR CAPACITOR VOLTAGE TRANSFORMERS
(To be filled in by the Bidder separately for each type and voltage rating)

1. Type of tank/Installation

2. Type of mounting

3. Manufacturer's Name, Address and Country of Manufacture

4. Conforming to standard

5. Type of voltage transformer

6. Type of insulation used

7. Rated primary voltage (kV rms)

8. Highest system voltage (kV rms)

9. Rated Secondary Voltage (volts)	For winding-I	Winding-II	Winding-III
10. Rated Transformation ratio	---	---	---
11. Rated secondary Burden(VA)	---	---	---
12. Rated thermal burden(VA)	---	---	---
13. Accuracy at rated burden	---	---	---
14. Rated frequency (Hz)	---	---	---

15. Temp. rise of winding by resistance (deg.c)

16. Primary winding one minute power frequency withstand voltage kV (r.m.s)

17. Impulse withstand Voltage 1.2/50 micro Sec.full wave positive
And negative impulse withstand voltage KV(peak)

18. One minute power frequency withstand voltage of secondary winding kV (r.m.s)

19. Maximum dynamic P.F.overvoltage kV (peak)

20. Maximum Radio interference voltage at 266 kV r.m.s (micro volts)

21. Corona inception and extinction voltage 9 kV(r.m.s)

22. Capacitance (+ 10% -5%)

23. a) Dielectric Dissipation factor & its Measured Voltage
    b) Total creepage distance of bushing (mm)
    c) Protected creepage distance of bushing (mm)

24. Overall height(mm)

25. Total weight (mm)

26. Type test report (Report No.)

27. Min. recommended spacing between voltage transformers

28. Outline dimension drawing No. giving clearance for installation (Drg.No.)

29. Mounting flange dimensional details.

30. Rated voltage Factor

31. Partial discharge level at rated voltage for capacitance divider (pc)

32. Seismic acceleration (horizontal) (g)

33. No. of terminals in terminal box

34. Primary and secondary windings made out of (copper only)

35. Tank material & tank coating (as per clause 3.1.3, 3.1.4)

36. Hardware exposed to atmosphere (as per clause 3.1.4)

37. Bolts, nuts and washers (as per clause 3.1.4)

38. Porcelain housing and its make (singular piece only as per clause 3.1.2)

39. Sealing (nitrogen gas cushion/metal bellow as per clause 3.1.7)

40. Whether supply includes terminal connectors.

41. Insulating oil
a) Type (Paraffinic/Napthenic)
b) Standard
c) Qty. (in Litres or Kg.) (To be mentioned by the manufacturer as per design)

42. Whether all seals are of "O" ring type

43. Whether all "O" Rings are fixed in machined grooves with adequate space for compression

44. Whether the main hollow insulator has the cost iron flanges cemented at both ends

45. Month & Year of Type Tests Conducted

46. Additional Information:

a) "O" ring / Gasket details (Make , Material & Thickness)
b) Details of metallic bellows (Make, Material, Applicable standard)
c) Raw material suppliers (Primary & Secondary)

Name of the firm .....
Signature of Bidder.....
Name, Designation & Seal .....
Date .....

ANNEXURE – IV

WINDING WISE DETAILS OF CAPACITOR VOLTAGE TRANSFORMERS

Sl	No.of Windings	Winding No.	Secondary Voltage (V)	Application Simultaneous Class	Accuracy out put	burden (VA)
1.	220 kV CVTs					
	3	1	110/√3	Metering	0.2	30
		2	110/√3	Metering/ Protection	3P	30
		3	110/√3	Protection	3P&0.5	30
2	132kV CVTs					
	3	1	110/√3	Metering	0.2	30
		2	110/√3	Protection	3P&0.5	30

3. Rated thermal (Simultaneous) burden for the above:

60VA(132kV) 90VA(220kV)

ANNEXURE – V

SCHEDULE OF TECHNICAL & GUARANTEED PARTICULARS FOR PTs

(To be filled in by the tenderer separately for each voltage rating)

220 KV 132KV 33Kv

1. Type

2. Manufacturer's type /Designation

3. Mounting of tank (Bottom)

4. Conforming to Standard

5. System rated voltage/highest voltage (kv)

6. Rated primary voltage (kv)

7. Secondary winding details:

	Winding – I	Winding – II	Winding – II
a) No.of secondary windings			
b) Rated secondary voltage(v)			
c) Rated burden (VA)			
d) Class of accuracy			

Voltage Transformers shall carry 25% above the rated burden continuously without injury in respect of voltage Transformers.

8. Temperature rise at 1.1 times rated voltage with rated burden (deg.C)

9. Rated voltage factor and time.

10. Temperature rise for item (9) above (deg.C)

11. Impulse withstand test voltage (KV) peak.

12. One minute power frequency withstand test voltage on primary (KV rms)

13. One minute power frequency withstand test voltage on secondary (KV rms)

14. Porcelain Bushing (make)

15. Total creepage distance of the bushing (mm)

16. Protected creepage distance of the bushing (mm)

17. Seismic acceleration (horizontal) (g)

18. Maximum Radio interference voltage:

19. No. of terminals in terminal box

20. Primary and secondary windings made out of:
21. Tank material & tank coating (as per clause 3.1.3, 3.1.4)

22. Hardware exposed to atmosphere (as per clause 3.1.4)

23. Bolts, nuts and washers (as per clause 3.1.4)

24. Insulating oil

(a) Type (Paraffinic/Napthenic)
(b) Standard
© Qty. (in Litres or Kg.) (To be mentioned by the manufacturer as per design)

25. Total weight including oil (Kg).

26. Dielectric Dissipation Factor & Measured Voltage.

27. Mounting details

28. Live parts to ground clearance

29. Sealing (Nitrogen gas cushion/Metal bellow)

30. Overall dimensions:
Height mm
Length mm
Breadth mm
31. Whether all seals are of "O" ring type
32. Whether all "O" Rings are fixed in machined grooves with adequate space for compression
33. Whether the main hollow insulator has the cost iron flanges cemented at both ends
34. Month & Year of Type Tests Conducted

35. Additional Information:
a) "O" ring / Gasket details (Make , Material & Thickness)
b) Details of metallic bellows (Make, Material, Applicable standard)
c) Raw material suppliers (Primary & Secondary)

Name of the firm .....

Signature of Bidder.....

Name, Designation & Seal .....

Date .....

ANNEXURE – VI

WINDING WISE DETAILS OF PTs

Sl. No.	No.of Windings	Winding No.	Secondary Voltage (V)	Application Simultaneous	Accuracy Class	output burden(VA)
1.	**220 kV PTs**					
	3	1	110/√3	Metering	0.2	50
		2	110-110/√3	Protection	3P&0.5	50
		3	110/√3	Protection	3P&0.5	50
2.	**132kV PTs**					
	3	1	110/√3	Metering	0.2	50
		2	110-110/√3	Protection	3P&0.5	50
		3	110/√3	Protection	3P&0.5	50
3.	**33kV PTs**					
	2	1	110/√3	Metering	0.2	50
		2	110-110/√3	Protection	3P&0.5	50
4.	**Metering PTs**					
	1	1	110/√3	Metering	0.2	10

Note :

1. **The ratios for secondary core of the PTs shall be confirmed along with drawing approval.**
2. **For Item-4, the secondary shall be terminated in a separate terminal box with provision for sealing.**
3. **For item-4, 100% PTs shall be tested for accuracy at 3rd Party NABL accredited laboratory and all inspection charges in this connection shall be borne by the supplier.**

Anexure-VII : Actions required in case of defects observed during warrantee period

Equipment	Nature of problem	Corrective measures to be taken by contractor
CT (SF6 filled)	a) SF6 gas leakage b) High Dew point of SF6 gas (> -36 deg C at atm press)	a) Repair/ replacement b) Re-processing of gas and replacement of Gas in case of no improvement
CT & PT (Oil filled)	Violation of Tan delta Tan Delta: >0.5% (during pre-commissioning) >0.7% (in operation) Or change w.r.t. to previous year value > 0.1%	Replacement of CT / PT
CT , PT & CVT	- Oil leakage - Low oil level - Sec winding problem leading to open/ short circuit, saturation etc	Replacement or repair as per repair procedure approved by QA.
CVT	Secondary voltage drift : Upto ± 0.5 volts Healthy a) ± 0.5 or beyond	a) CVT to be replaced

*** Replaced/ Repaired/ Refurbished Equipment (or part of equipment) shall have 5 years warranty without prejudice to contractual warranty period.**

A C R O N Y M S

MVA	Mega Volt Ampere
KVA	Kilo Volt Ampere
kV	Kilo Volt
Cu. m	Cubic metre
Deg. C	Degrees Centigrade
mm.	Millimetre
cm.	Centimetre
dm.	Decimetre
km.	Kilometre
g.	Grams
kg.	Kilogram
V	Volts
Hz	Hertz
DC	Direct Current
AC	Alternate Current
ONAN	Oil Natural Air Natural
ONAF	Oil Natural Air Forced
HV	High Voltage
IV	Intermediary Voltage
Db	Decibel
KA	Kilo Amperes
sec.	Seconds
Amps.	Amperes
kVp.	Kilo volts peak
kV. rms.	Kilo volts root mean square
KW	Kilo watt
Max.	Maximum
Min.	Minimum
UTS	Ultimate Tensile Strength
QAP	Quality Assurance Plan
ACSR	Aluminium Conductor Steel Reinforced
AAAC	All Aluminium Alloy Conductor
HP	Horse Power
ppm.	Parts Per Million

OLTC	On Load Tap Changer
WTI	Winding Temperature Indicator
OTI	Oil Temperature Indicator
Torr	Torr.
LOI	Letter of Intent
CIF	Cost including Insurance & Freight
CIP	Carriage Insurance Paid
SF6	Sulphur HexaFlouride
TRV	Transient Recovery Voltage
CTD	Capacitor Tripping Device
ICU	Individual Compressor Unit
NO	Normally Open
NC	Normally Close
sq.mm Al. Cable	Square millimeterAluminium cable
sq.mm Cu. Cable	Square millimeter Copper cable

MS Flat	Mild Steel Flat
C	Close
O	Open
HRC	High Rupturing Capacity
PVC	Poly Vinyl Chloride
p.f	Power factor
CT	Current transformer
NCT	Neutral Current Transformer
TEFC	Totally enclosed fan cooled
P.U.	Per Unit
ISO	Indian Standard Organization
CB	Circuit Breaker
Auto	Automatic
kg./Sq. mm	Kilogram per square millimete

ANNEXURE-F

NAME PLATE DETAILS OF CURRENT TRANSFORMER

Dimension-2

Standard		S.No.		Type	
Month/Y.O.M					
Class of Insulation					
Rated System Voltage		Highest System Voltage		Insulation Level	
Rated Primary Normal Current		Rated Continous Thermal Current		Rated Dynamic withstand Current kAp	
Rated Extended Primary Current		Frequency		Tan Delta at FAT	P.D at FAT
Sealing		Nitrogen Pressure		RIV	
Insulating Fluid Type		Insulating Fluid class		Insulating Oil Qty.	
Total Min. Creepage		Suitable for Hot Line Washing		Total Weight	

Dimension-1

Dimension-3

Details of Cores

Primary & Secondary windings in all cores and tappings								
	Current Ratios A/A							
	Output burden (VA)							
	Class of accuracy							
	Accuracy limit factor							
	Min. knee point voltage (kpV)							
	Secondary resistance (corrected to 75o							
	Max. exciting current at							
	Application							
	Core							
	Area of cross section							
	Flux density at rated current & rated burden.							

Name of customer

P.O. Deatails

CAUTION

Danger Mark

Manufacturer details including company logo, postal address, state and country

Dimension-4